GAIA

NATURAL CAPITAL

BLUE CARBON

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BLUE CARBON

The term Blue Carbon was coined a decade ago to describe the disproportionately large contribution of **coastal vegetated ecosystems** to global carbon sequestration[1].

The potential for Blue Carbon ecosystems to combat climate change and provide co-benefits is attracting increasing investor interest.

Coastal vegetated ecosystems comprise sea grasses, mangroves, and salt marshes along coastlines.

These ecosystems build up large stocks of carbon through living biomass and soil. Carbon storage can be to **1,000 tonnes of carbon dioxide equivalent per hectare**[2].

To translate this into a monetary value - at the current Blue Carbon price of circa $US40 per tonne – this represents a carbon valuation of $US40,000 per hectare. This is significantly more than the value of highly productive agricultural land[3].

This valuation highlights the economic incentive to protect existing coastal vegetated ecosystems, but also the value that can be created from **restoration.**

Despite the importance of Blue Carbon – it is not a well understood concept and there are few projects of scale for investment. This stems from difficulties in delineating property rights, project establishment costs and measuring carbon sequestration.

We expect these constraints to ease over the short to medium term, on the back of education around the value of coastal vegetated systems, application of technology and strong investor appetite.

1 Macreadie et al, 2017

2 The role of Blue Carbon in Climate Change Mitigation and Carbon Stock Conservation, Jimli et al, 2021

3 Green Payments for Blue Carbon – Economic Incentives, 2011

MANGROVE FORESTS

Mangrove forests are one of the major types of coastal vegetated systems. Globally, they cover circa 15 million hectares, compared to 4 billion hectares of forest.

Mangroves play a key role in human sustainability and livelihoods. They are heavily used for food, timber, fuel, and medicine. They also offer protection from catastrophic events, such as tsunamis, tropical cyclones, and tidal bores - and can dampen shoreline erosion.

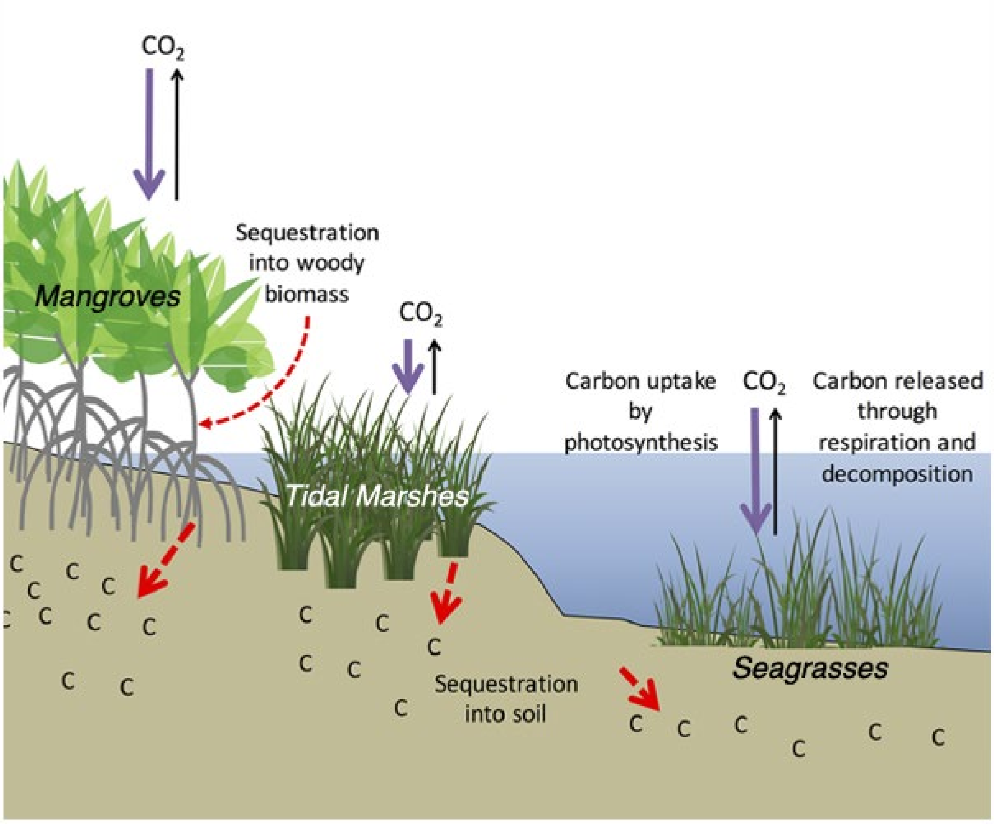
This interaction with human activity has also had negative impacts that have resulted in mangrove forest degradation. These activities include aquaculture, fisheries, coastal tourism, coastline development and waste-water discharges.

Over the past half century, these impacts have resulted in a **30-50% decline in mangrove forest**. If this decline continues - mangroves could functionally disappear in as little as 100 years.

CARBON STRUCTURE OF MANGROVE FORESTS

Like most forest ecosystems, mangroves can be roughly divided into four carbon pools:

1. **Above ground living biomass** (trees, scrub trees, lianas, palms) – **20%** of carbon stock;
2. **Above ground dead biomass** (litter, dead trees) – **5%** of carbon stock and excluded from carbon analysis;
3. **Below ground living biomass** (roots) – **10%** of carbon stock; and
4. **Soil carbon** which includes the dead below-ground biomass. – **65%** of carbon stock.



Source: Land Trust Alliance, Conservation in a Changing Climate

CARBON STRUCTURE OF MANGROVE FORESTS

Carbon emissions resulting from mangrove forest loss is material.

One study attempted to quantify global ecosystem carbon storage by measuring tree and dead wood biomass, soil carbon content, and soil depth in mangrove forests across the Indo-Pacific region.

The analysis estimated that mangrove deforestation generates emissions of up to **one gigatonne of carbon per year**. For context, it is estimated deforestation accounts for circa five gigatonnes of tonnes of carbon dioxide released into the atmosphere.

The carbon released from the destruction of mangrove forests represents around **20% of emissions from global deforestation** - despite accounting for just 0.7% of tropical forest area.

EMISSION REDUCTION REQUIRES NATURE-BASED SOLUTIONS

It is estimated 500 billion tonnes of carbon dioxide has been released into the atmosphere since the beginning of the industrial revolution. The consensus is that an additional 45 billion tonnes of carbon dioxide is released into the atmosphere from human activity each year.

Expectations are forming that meeting the objective for the global economy to move to 'net zero'- where there are no additional carbon emissions – will require nature-based solutions.

Alone, destruction of coastal vegetated systems accounts for approximately 2% of global carbon emissions. In aggregate deforestation and land-use change accounts for up to 20% of global human induced carbon dioxide - **second only to fossil fuel combustion emissions.**

Reversing this trend by protecting and restoring natural ecosystems will be an important component of reducing annual carbon emissions.

ILLUSTRATION OF MANGROVE FOREST DETERIORATION

CARBON SEQUESTRATION AND VALUING CO-BENEFITS FROM RESTORATION

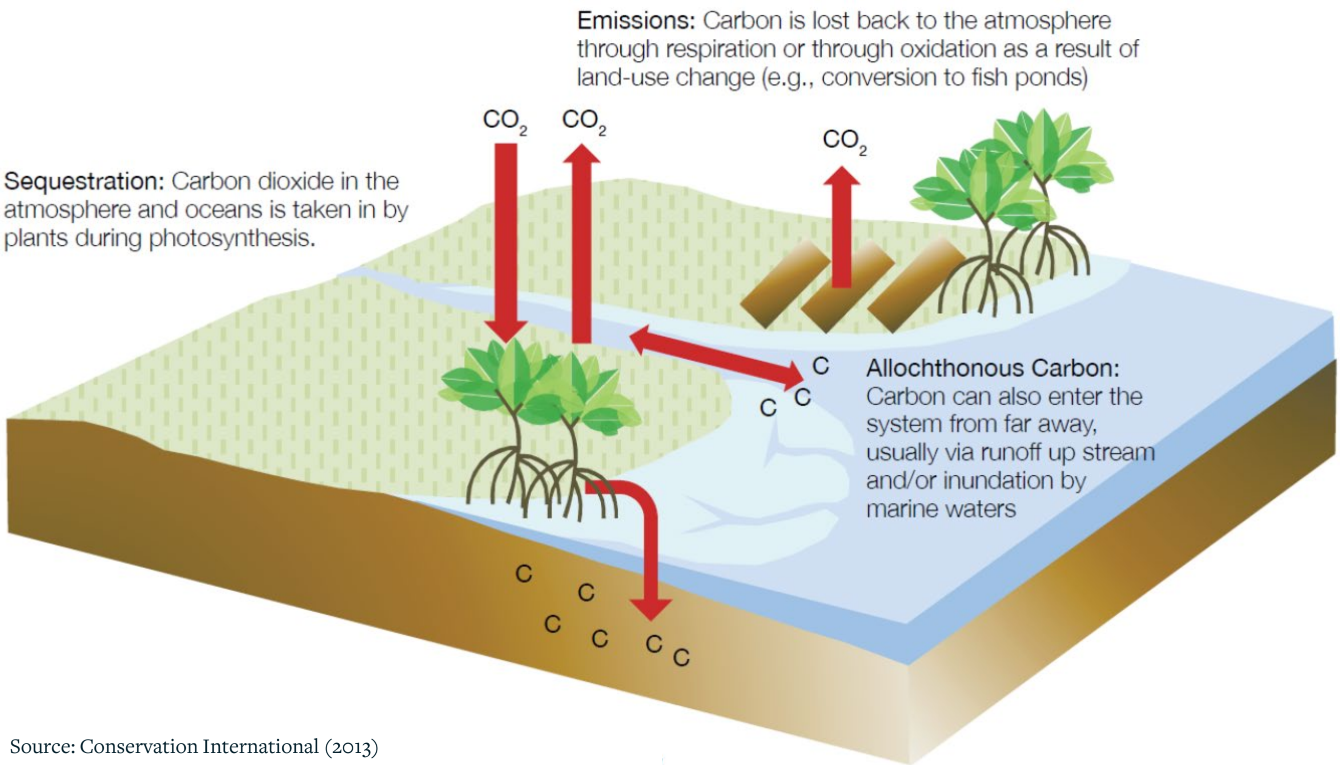
Measuring carbon sequestration of coastal vegetated systems is more challenging than terrestrial measurement.

Apart from being geographically challenging with often difficult access - these ecosystems sequester carbon in different fields. Carbon is stored within soil, the living biomass (trees) and below ground (roots) – making carbon sequestration measurement difficult.

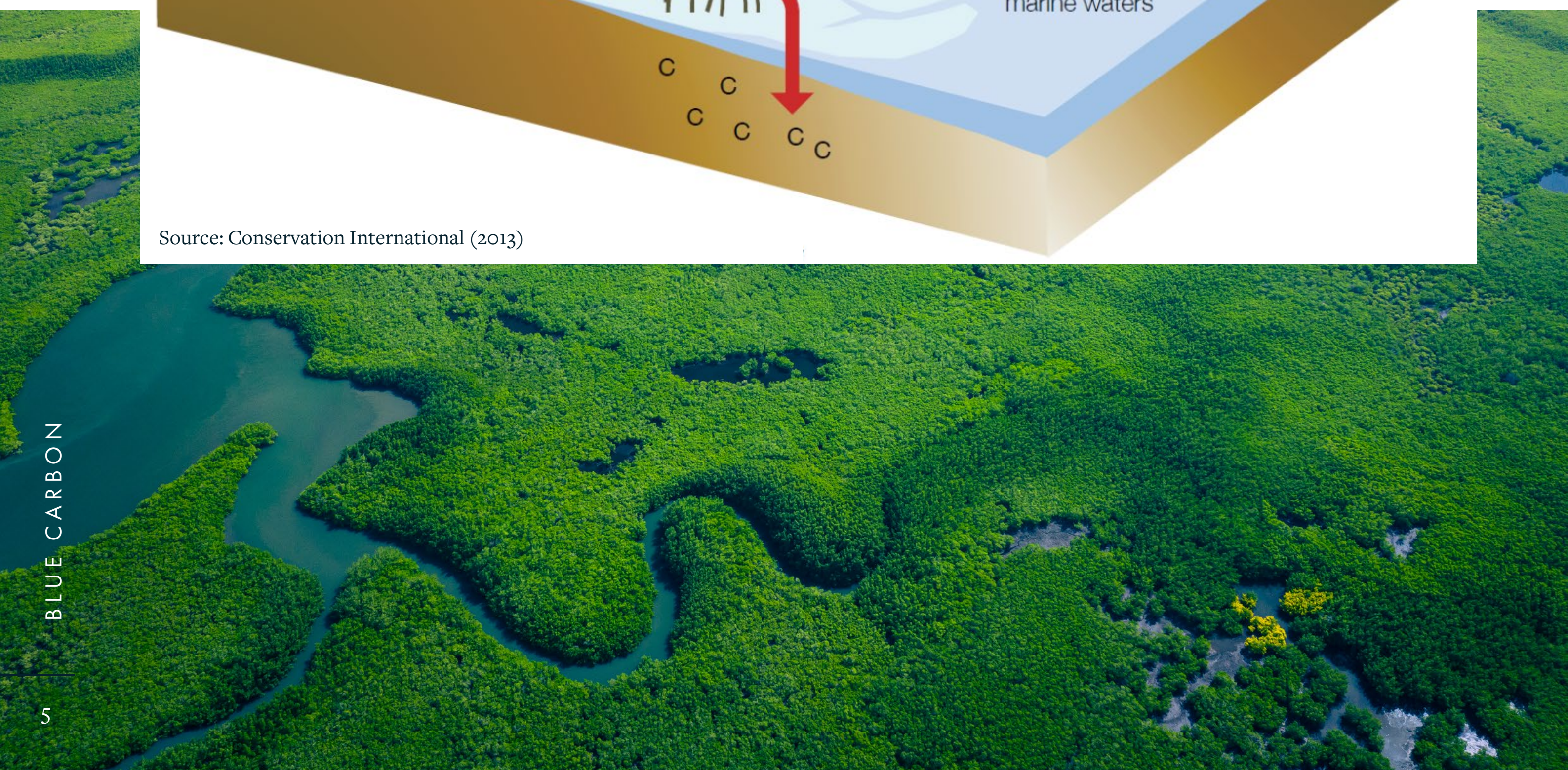
For example, measuring carbon in soil within mangrove forests is made difficult because it is clay like, tidally submerged, has varying thickness.

Time is also a factor; Blue Carbon is sequestered over the short term in biomass and over longer time scales in sediments.

Fortunately, technology is evolving to combat some of these issues. There is technology being introduced that can measure carbon capture and storage in real time.



Source: Conservation International (2013)



EXAMPLES OF BLUE CARBON PROJECTS

Because of the cost of project establishment, delineating property rights and carbon measurement difficulties - there are very few Blue Carbon projects globally.

Nonetheless, there are examples of highly successful Blue Carbon projects.

The best example of a Blue Carbon projects is the **Indus Delta Blue Carbon project.**

The Indus Delta Blue Carbon project in Pakistan is one of the largest environmental restoration projects in the world.

Over the project's lifetime of 60 years, it will sequester **142 million tonnes of carbon dioxide equivalent** over its 250,000-hectare ecological footprint. For context, this is 0.14 gigatonnes – annual global e emissions are 45 gigatonnes.

After many years of development, the project is now moving into commercial phase – **generating circa $US50 million per annum in revenue.**

The project is materially improving the lives of the local indigenous community. The project will provide 43,000 jobs for the community, as well as create a culture of custodianship – ensuring the project's success and longevity.

Now the project is in cash generative territory, the developer will continue to reinvest in the project. The manager intends to apply technology to improve project execution and improve monitoring and measurement capability. The developer will also continue their program of lifting local infrastructure.

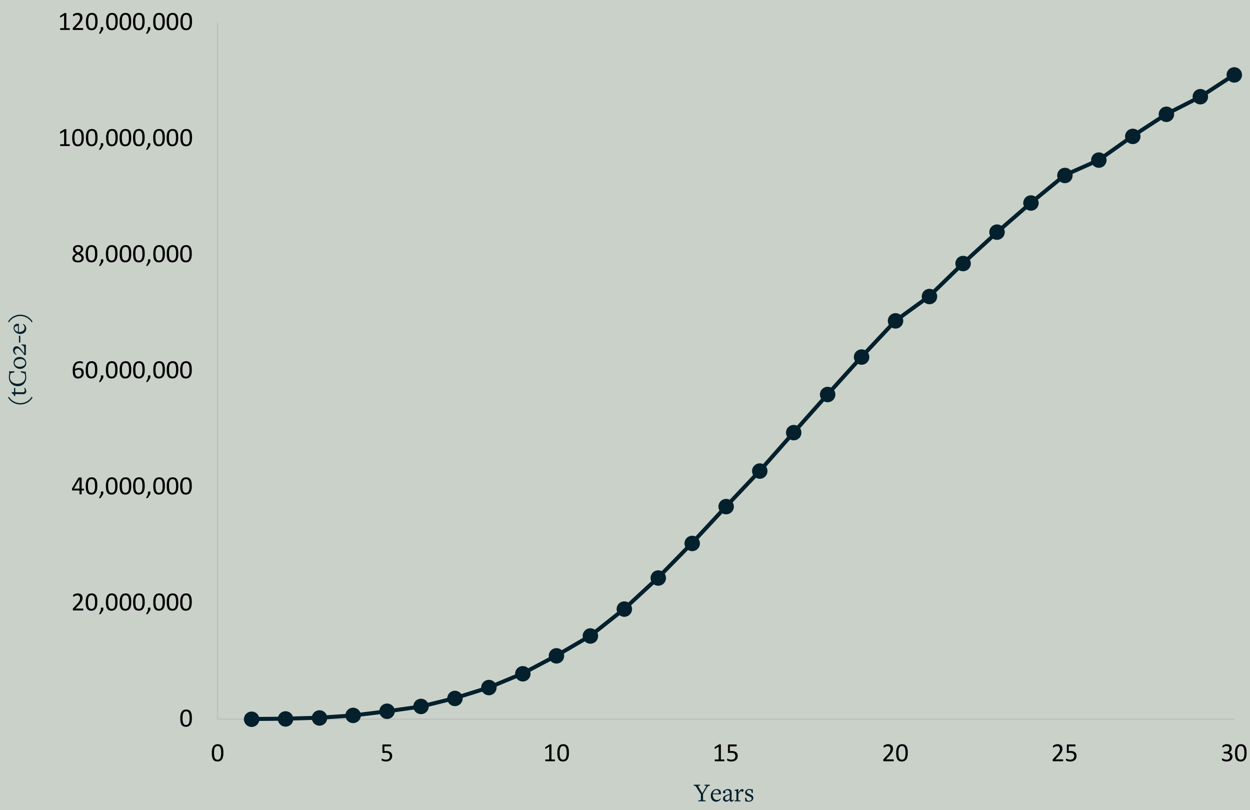
Finally, the biodiversity benefits are excellent – while overall biodiversity will lift across all species - there are several endangered species that will benefit from the restoration.

INDUS DELTA BLUE CARBON

The Indus Delta Blue Carbon Project is expected to achieve 142 million tonnes of carbon emission removals over the 60-year project lifetime.

The economic value creation from the project using 'natural capital value added' framework is **$US 686 million**. This value is generated from the carbon credit generation for the first 40 years of the project life, with cashflows discounted at 10%.

INDUS DELTA BLUE CARBON – GREENHOUSE GAS REMOVALS OVER TIME



CONCLUSION

Blue Carbon projects can protect coastal vegetated systems from degradation, as well as restore them.

Blue Carbon projects are economically viable at Blue Carbon credit prices of $US40 per tonne or greater. The potential revenue generation has attracted significant investor interest.

The capital to establish Blue Carbon projects will be a major store of carbon dioxide emissions, as well as sequestering carbon from the atmosphere in the case of restoration.

We expect Blue Carbon projects to become a major force in reducing carbon emissions via nature-based solutions.

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